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Growth of Synthetic Silver Wires from Natural Acanthite

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Wire silver is an unusual crystal habit of native silver which is intimately associated with acanthite (Ag_2S). These delicate wires have been collected for several centuries, but much remains unknown regarding their growth mechanism and crystal structure. This study has successfully produced synthetic silver wires from natural acanthite in order to investigate the nature of their crystallinity.

Chunks of crude acanthite crystals from the Hongda mine, Shanxi Province, China, were trimmed into roughly 1 cm chunks for growth experiments. Preexisting silver wires, which appeared to be natural, were avoided.

Several techniques were explored with varying degrees of success. Attempts using a benchtop furnace failed to produce any wires. However, a silver film, which formed on the acanthite surface, confirmed that decomposition of the sulfide indeed occurs in excess of 450°C. Samples exceeding about 700°C melted rapidly and erased all growth. Many samples became coated in a red crust-forming mineral, likely an iron oxide, which appears to stifle wire growth. Holding samples directly inside the inner cone of a Bunsen burner flame produced wires up to 7 mm long in one hour. The best results were achieved by heating samples in a crucible with a silver solder flux, which produced many wires longer than 1 cm. The two most important factors for successful wire growth were 1) controlling the temperature range and gradient, and 2) preventing metal oxides, especially iron oxides, from forming.

The typical resulting wire morphology was a blade or neuron-shaped base at the acanthite interface, which transitioned to a cylinder and terminated in a wisp or curl. The scale of the wires appears to be a continuum, ranging from a couple microns to several millimeters in diameter. It was observed on every scale that wires originated in little patches of fine solitary growths. As each wire extended, they coalesced with adjacent wires, producing larger codirectional aggregates with a striated surface.

A 200-micron long, 100-micron wide blade of synthetic wire silver was analyzed with single crystal diffractometry. The results were distinctly polycrystalline, as complete Loue rings of heterogeneous intensity were produced.